

# **SIGNIFICANT NASA INVENTIONS**

## **Available for Licensing in Foreign Countries**

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National Aeronautics and Space Administration  
Washington, D.C., U.S.A.

1971

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## **PREFACE**

### **NASA FOREIGN PATENT LICENSING PROGRAM**

The foreign licensing program of the National Aeronautics and Space Administration serves to promote and utilize foreign patent rights vested in the Administration. The objective of this program is to extend the patent coverage on valuable NASA-owned inventions to various foreign countries in order to further the interests of United States industry in foreign commerce, to enhance the economic interests of the United States, and to advance the international relationships of the United States.

Licenses will be individually negotiated and may be granted to any applicant, foreign or domestic, on a nonexclusive or exclusive basis for royalties or other considerations and on such other terms and conditions as are deemed appropriate to the interests of the United States. Preference in the granting of foreign license rights will be shown to those applicants who have previously been granted a license under the corresponding U.S. patent or patent application. The NASA Foreign Patent Licensing Regulations, 14 C.F.R. 1245.400 et seq., are reproduced on page 1.

This publication includes abstracts of those inventions in which NASA owns the principal or exclusive rights and which have been made available for patent licensing in the countries indicated. The corresponding U.S. patent number is also listed. Copies of the U.S. patents may be purchased directly from the U.S. Patent Office, Washington, D.C. 20231 for fifty cents a copy. Some of these inventions have been licensed by NASA in one or more of the indicated countries. All inquiries, requests for additional information, and applications for license should be addressed to:

Assistant General Counsel for Patent Matters  
National Aeronautics and Space Administration  
Washington, D.C. 20546.



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# **TITLE 14—AERONAUTICS AND SPACE**

## **Chapter V—National Aeronautics and Space Administration**

### **PART 1245—PATENTS**

#### **Subpart 4—Foreign Patent Licensing Regulations**

New Subpart 4 is added:

#### **Subpart 4—Foreign Patent Licensing Regulations**

Sec.

1245.400 Scope of subpart.

1245.401 Policy.

1245.402 Types of licenses and terms and conditions.

1245.403 Government license.

1245.404 Enforcement of patent rights.

1245.405 Procedures.

**AUTHORITY:** The provisions of this Subpart 4 issued under 42 U.S.C. 2457 (g) and (h).

#### **§ 1245.400 Scope of subpart.**

(a) The subpart establishes the policy, terms, conditions, and procedures under which NASA-owned foreign patents and patent applications may be licensed.

(b) The provisions of this subpart apply to all NASA-owned patents granted in countries other than the United States and to NASA-owned patent applications pending in such countries and supplement the provisions of Subpart 2 of this part for foreign patent licensing.

#### **§ 1245.401 Policy.**

The foreign licensing program of the National Aeronautics and Space Administration serves to promote and utilize foreign patent rights vested in the Administration. The objectives of this program are to further the interests of United States industry in foreign commerce, to enhance the economic interests of the United States, and to advance the international relationships of the United States.

#### **§ 1245.402 Types of licenses and terms and conditions.**

Licenses will be individually negotiated and may be granted to any applicant, foreign or domestic, on a nonexclusive or exclusive basis for royalties or other considerations and on such other terms and conditions as are deemed appropriate to the interests of the United States. Preference in the granting of foreign license rights will be shown to those applicants who have previously been granted a license under the corresponding U.S. patent or patent application.

#### **§ 1245.403 Government license.**

There will be reserved from each exclusive license an irrevocable, nonexclusive, nontransferable, royalty-free license for the practice of such invention throughout the world by or on behalf of the United States or any foreign government pursuant to any existing or future treaty or agreement with the United States.

#### **§ 1245.404 Enforcement of patent rights.**

An exclusive licensee will be authorized to enforce the licensed patent and to sue infringers of the patent at its own expense.

#### **§ 1245.405 Procedures.**

(a) NASA will publish in the United States, and elsewhere as may be appropriate, lists of NASA-owned foreign patents or patent applications available for licensing.

(b) NASA will also furnish written notice of the availability for licensing of NASA-owned foreign patents or patent applications to any licensee under the corresponding U.S. patent or patent application.



(c) Applications for license should be addressed to the Administrator, National Aeronautics and Space Administration, Washington, D.C. 20456. The application must fully identify the patent or patent application, and state the type of license requested together with proposed terms and conditions thereof.

(d) The conduct of negotiations with prospective licensees will be the responsibility of the General Counsel, NASA. In the conduct of such negotiations, due regard shall be had for the possible interests of NASA program and staff offices, and their coordination will be obtained as deemed appropriate.

(e) NASA will publish notice in the FEDERAL REGISTER, and elsewhere as may be appropriate, of its intention to grant an exclusive license under an identified patent or patent application. An exclusive license will not be granted until the expiration of 60 days from the date of notice in order to provide a suitable time interval for interested persons or other Government agencies to interpose comment or objection.

(f) All licenses shall become effective upon the written acceptance by the licensee of a license instrument specifying the type of license and terms and conditions thereof.

*Effective date.* The provisions of this Subpart 4 are effective upon publication in the FEDERAL REGISTER.

JAMES E. WEBB,  
*Administrator.*

[F.R. Doc. 66-8920; Filed, Aug. 17, 1966; 8:45 a.m.]

FEDERAL REGISTER, VOL. 31, NO. 160—THURSDAY, AUGUST 18, 1966

Listed below are abstracts of various NASA-owned inventions which are available for foreign licensing in the identified countries in accordance with the NASA Foreign Patent Licensing Regulations, published on August 18, 1966, in 31 Federal Register 10958-10959. Inquiries and all requests for licenses should be directed to Assistant General Counsel for Patent Matters, Code GP, National Aeronautics and Space Administration, Washington, D.C. 20546.

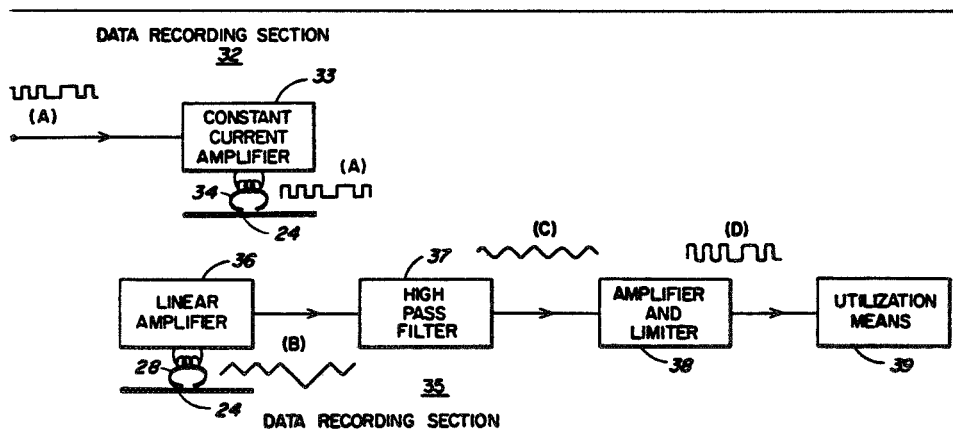
## SYSTEM FOR RECORDING AND REPRODUCING PULSE CODE MODULATED DATA

NASA Case No. XGS-01021

Canada

[Corresponding to U.S. Patent No. 3,277,373]

In pulse code modulated magnetic tape recording and reproducing (playback) systems, the playback head tends to alter the shape of the recorded signal. Accordingly, the reproducing system must reconstruct the proper signal from the altered one. This invention eliminates the need for this reconstruction function by the design of the playback head in which the head gap is approximately one-half the wave length of the recorded pulse code modulated data at its fundamental pulse repetition frequency. The playback head thus provides an output signal which is an integral of the recorded signal and contains all of the recorded information. The invention also allows a higher packing density of the recorded information on the magnetic tape.



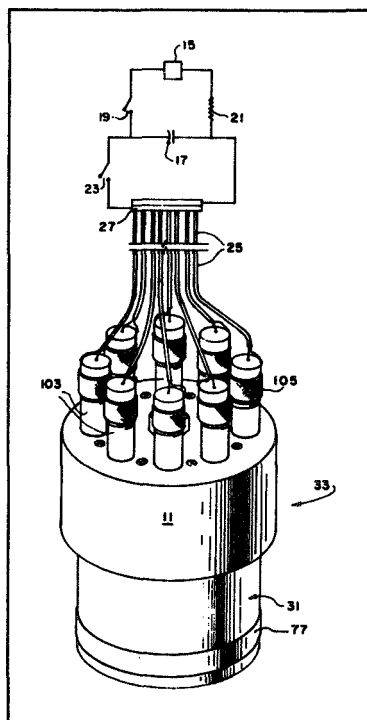
# MAGNETOMOTIVE METAL WORKING DEVICE

NASA Case No. XMF-03793

Canada, France, Holland,  
Italy, Japan, Sweden,  
United Kingdom, West Germany

*[Corresponding to U.S. Patent No. 3,360,972]*

A portable magnetic hammer, a metal working device developed in the course of the Saturn program, wherein energy for manipulating a metal workpiece is acquired by creating a high-intensity magnetic field from a controlled electrical discharge into a conductor coil. This compact, lightweight device performs sizing, blanking, and stress removal functions without surface marring of the metals. It is expected that the magnetic hammer would find use in many environments particularly in removing dents, deformed or depressed surfaces from vehicles, fenders and bodies, tanks, etc.



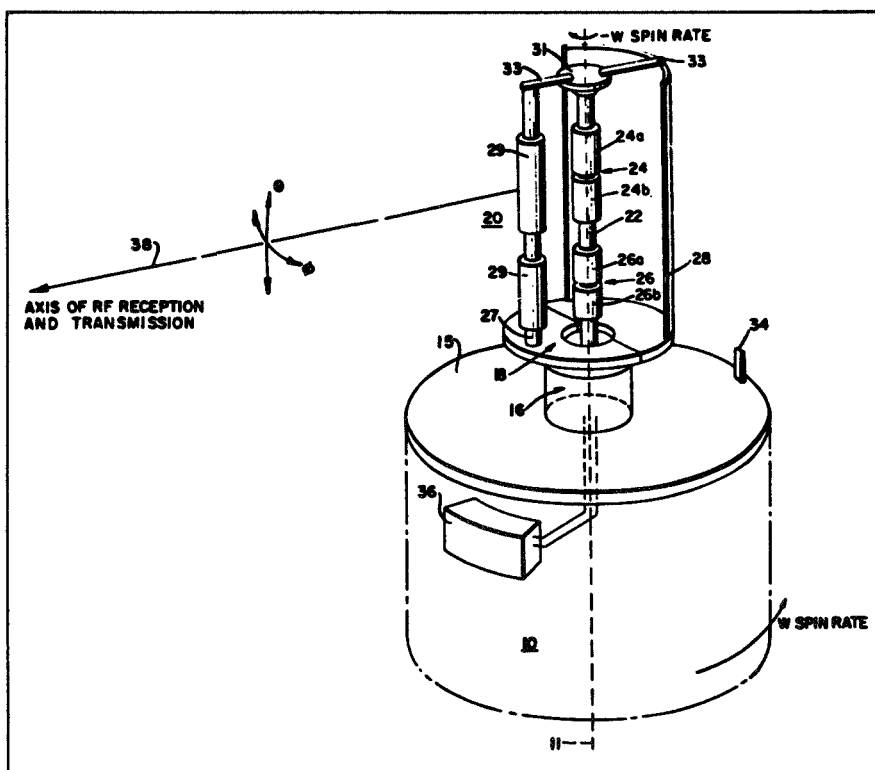
# APPARATUS PROVIDING A DIRECTIVE FIELD PATTERN AND ATTITUDE SENSING OF A SPIN-STABILIZED SATELLITE

NASA Case No. XGS-02607

Australia, Canada, France, Holland,  
Italy, Japan, Sweden,  
United Kingdom, West Germany

*[Corresponding to U.S. Patent No. 3,341,151]*

A satellite, adapted to spin about an axis, having antenna elements for communicating with a remote body and a beam collimator rotatable with respect to the spin axis. The beam collimator is rotated at the same rate and in the opposite direction as the spin of the satellite to provide a directional beam stationary in space. Ejection apparatus enables the collimator to be jettisoned in event of rotational malfunction so that an omnidirectional beam may be provided about the spin axis. Signal processing circuitry operating in conjunction with the antenna elements provides information concerning the attitude of the satellite.



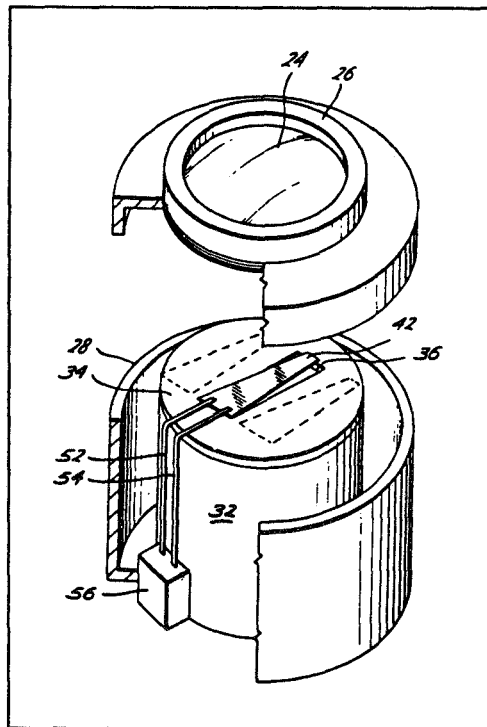
# LIGHT DETECTION SYSTEM

NASA Case No. XMS-01059

Canada, France, Italy,  
Japan, United Kingdom,  
West Germany

[Corresponding to U.S. Patent No. 3,354,320]

A system for determining the position of a light source about two axes of a reference position. The system, originally developed for orienting antenna on the Mariner spacecraft, utilizes a single movable part, a vibrating reed shutter, for alternately blocking and passing light from the source projected onto a photosensitive detector at the position of reference.



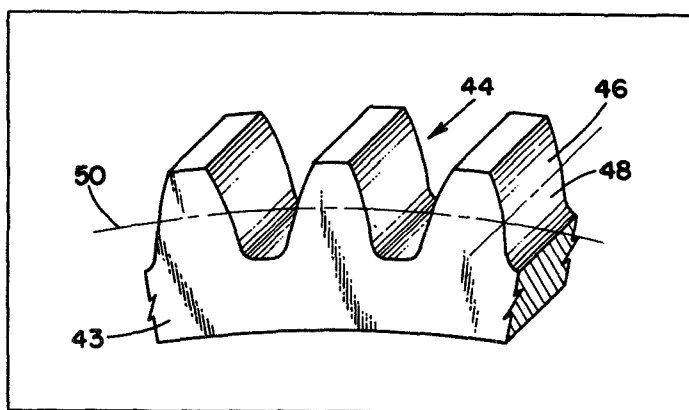
# METHOD OF IMPROVING THE RELIABILITY OF A ROLLING ELEMENT SYSTEM

NASA Case No. XLE-02999

Canada, France, United Kingdom

*[Corresponding to U.S. Patent No. 3,262,186]*

Current bearing manufacturing practice generally specifies that bearings shall have balls or rollers of hardness equal to the hardness of the races. This invention method greatly improves the load capacity and fatigue life of roller element systems by controlling the relative hardnesses such that the hardness of the elements subjected to the greater number of stress cycles is less than that of the elements engaging them by an amount between one and two points as measured on the "Rockwell C" Scale.



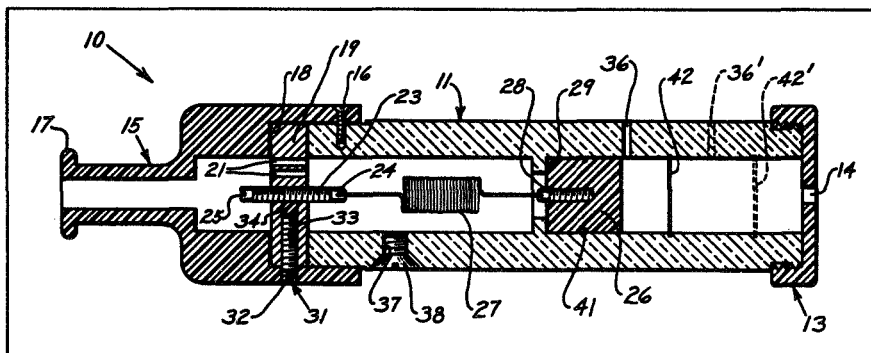
# INSTRUMENT FOR USE IN PERFORMING A CONTROLLED VALSALVA MANEUVER

NASA Case No. XMS-01615

Canada, France, Italy, United Kingdom

*[Corresponding to U.S. Patent No. 3,298,362]*

One of the clinical tests in the evaluation of the cardiovascular system of a human being is the Flack test which requires the imposition of a known constant pressure (greater than atmospheric) within the lungs and thorax and then a sudden release of the overpressure. The changes in the pulse rate and blood pressure of the subject associated with this maneuver (called a Valsalva Maneuver) are used in the Flack test as indicators for evaluating the cardiac control mechanism. Known devices for performing this maneuver have the disadvantages of requiring a gravitational field for proper readings of a manometer, large size, and fragile construction. There also is a possibility that the subject will use cheek muscles rather than the thoracic muscles, rendering incorrect results. This invention is rugged and compact, requires use of the thoracic muscles, and is not dependent upon the presence of a gravitational field for operation.



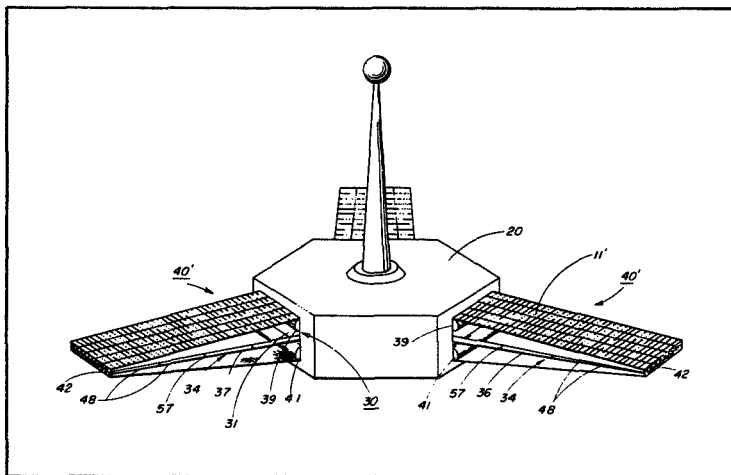
# INTERCONNECTION OF SOLAR CELLS

NASA Case No. XGS-01475

Australia, Belgium, Canada, France,  
Holland, Italy, Japan, United Kingdom,  
West Germany

*[Corresponding to U.S. Patent No. 3,459,391]*

Expanded metal, that is, a thin metal strip which has first had short longitudinal cuts made therein and then been pulled transverse to the cuts to open the cuts into diamond shaped holes, has been used as interconnectors in a solar cell matrix to provide a flexible, somewhat resilient array. The solar cell array can be compactly stored prior to deployment and then deployed into a variety of shapes through the use of a new expandable frame in which telescoping tubes are extended to a desired length and then cemented to form a rigid support structure.



\*Exclusively licensed in Japan.



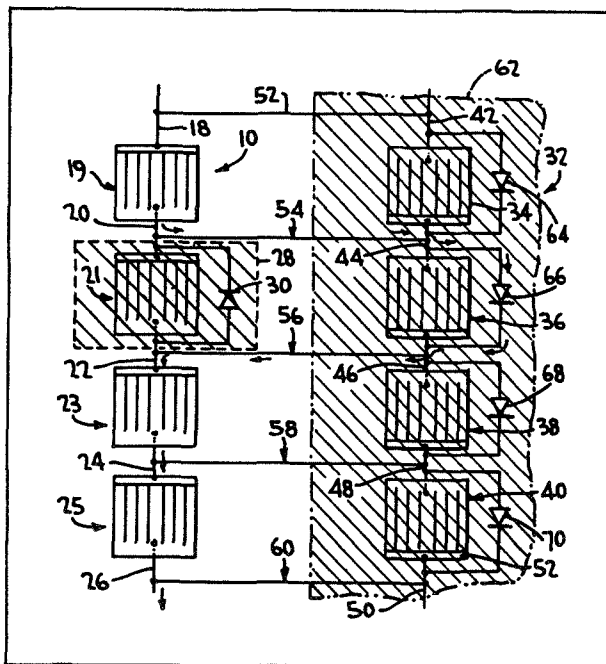
# USE OF UNILLUMINATED SOLAR CELLS AS SHUNT DIODES FOR A SOLAR ARRAY

NASA Case No. GSC-10344

Canada, France, Holland, Italy,  
Japan, United Kingdom, West Germany

*[Corresponding U.S. Patent—Application Pending]*

An improvement has been made in the electrical interconnection of solar cells in an array of solar batteries. Each individual cell of a shaded battery is electrically connected in parallel with a corresponding cell of an illuminated solar battery. The p-n junction solar cell of the shaded battery provides a forward biased diode equivalent in a by-pass conducting path around the corresponding illuminated cell in the event it becomes non-conductive. Thus, uninterrupted current flow is maintained in the event the illuminated cell fails to function.



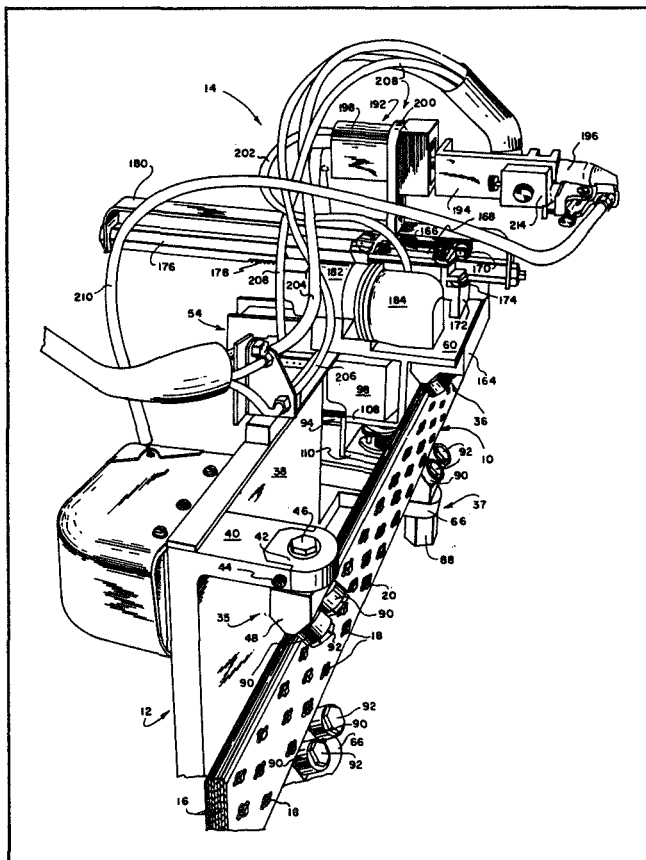
## WELDING SKATE AND TRACK

NASA Case No. XMF-01542

## Canada, Japan

[Corresponding to U.S. Patent No. 3,229,883]

A track and skate combination is commonly used in the precision welding of relatively large articles such as tanks, ship hulls, etc. The track is contoured to the desired shape and placed alongside and parallel to the seam to be welded. This invention features a reusable track fabricated of a plurality of laminates that is easily bent into any desired shape and a skate having individually pivoted sets of wheels which can negotiate sharp curves on the track.



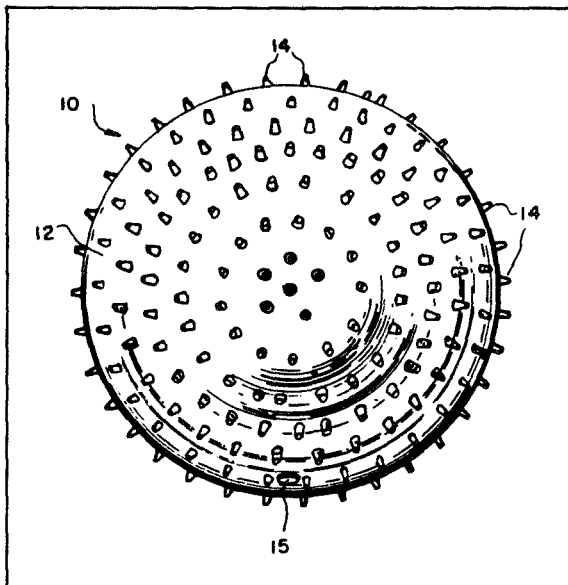
# FLUID FLOW SENSOR

NASA Case No. XMF-04163

Canada

[Corresponding to U.S. Patent No. 3,340,732]

A meteorological balloon having superior response and aerodynamic stability characteristics due to provision of a plurality of evenly dispersed protuberances on the balloon surface. These protuberances form a roughened surface to provide a more evenly distributed flow separation area to induce a larger balloon wake, resulting in greater stability in flight.



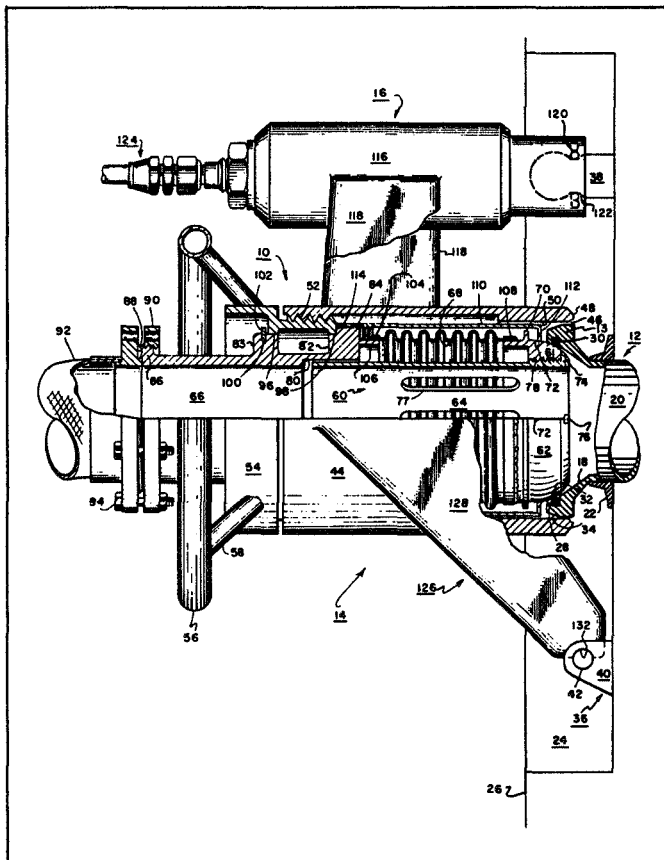
# FLUID COUPLING ASSEMBLY

NASA Case No. XKS-01985

Canada, France, United Kingdom,  
West Germany

[Corresponding to U.S. Patent No. 3,319,979]

A quick attach and release fluid coupling for use in those instances where it is desirable that the coupling not only be free from leaks, but also be both easily assembled together and separated. The mating conical and spherical sealing surfaces of this coupling serve to eliminate alignment problems. The coupling is ideally suited for use in cryogenic piping systems where icing conditions are encountered.



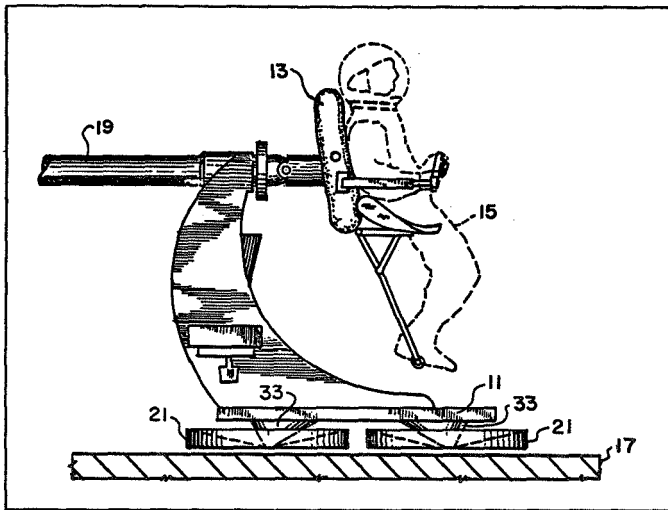
## AIR CUSHION LIFT PAD

NASA Case No. MFS-14685

Australia, Belgium, Canada, France,  
Holland, Italy, Japan, Sweden, Switzerland,  
United Kingdom, West Germany

*[Corresponding to U.S. Patent No. 3,534,826]*

An air cushion lift pad has been developed which utilizes an air cushion of pressurized air to support a device above a surface. The pad includes an upper wall which slopes upwardly from a center portion. Should the pad tend to tilt, the vertical lift force component acting on the inner wall will tend to decrease on the high side and increase on the low side, thereby producing a torque tending to stabilize the pad along the horizontal. A plurality of pads may be used and the design achieves a very stable device with no flutter, vibration, heaving or pitching. The lift pad may be employed to support an object, vehicle, etc. above a surface. Although the surface may be rough or unprepared, stability is achieved.



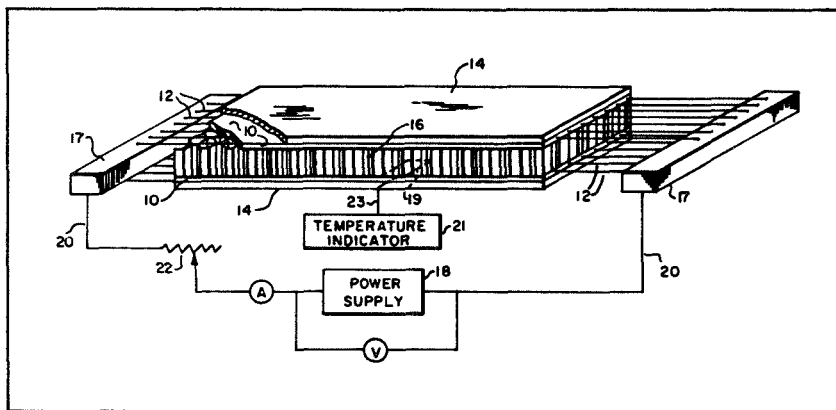
# HEAT CURING OF THERMOSETTING PLASTIC FILM ADHESIVES

NASA Case No. XMF-01402

France, Canada, Italy, United Kingdom

*[Corresponding to U.S. Patent No. 3,346,442]*

In order to manufacture strong lightweight metal panels for use in very large structures such as bulkheads in propellant tanks for spacecraft boosters or large aircraft, it is desirable to utilize a honeycomb structure. The difficulty experienced is in curing the thermosetting film which is used as the adhesive to bond the outer plates to the honeycomb core. It was impractical to place the panel in a curing oven since such an oven would have to be very large and it would not be satisfactory for other differently shaped panels. This invention provides curing of the thermosetting film by incorporating a heat producing means within the bonding material.



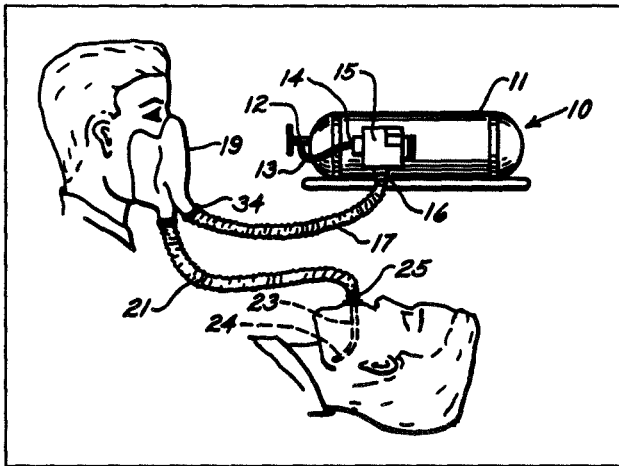
# RESUSCITATION METHOD AND APPARATUS

NASA Case No. XMS-01115

Canada

*[Corresponding to U.S. Patent No. 3,229,689]*

A more direct method has been developed to revive a person suffering from respiratory failure or arrest. By means of an airway or tube inserted into the throat, oxygen is delivered directly to the lungs of the patient. The increased intrapulmonic pressure induces ready assimilation of oxygen into the vascular system and employment of a tube or airway precludes pharyngeal blockage and the possibility of the subject's swallowing his tongue.



# POSITION LOCATION SYSTEM AND METHOD

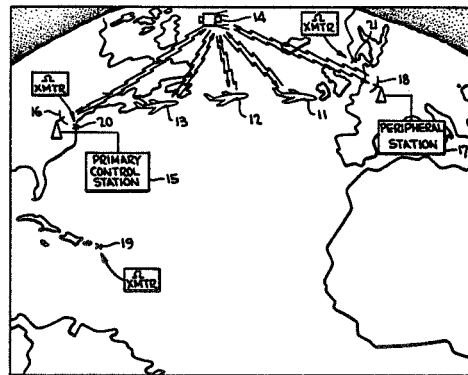
NASA Case No. GSC-10087-1

Australia, Belgium, Canada, France, Italy, Japan,  
Switzerland, United Kingdom, West Germany

[Corresponding to U.S. Patent No. 3,534,367]

System and method for position locating, deriving centralized air traffic control, data, and communicating via voice and digital signals between a multiplicity of remote aircraft (including supersonic transports) and a central station, as well as a peripheral ground station(s), through a synchronous satellite relay station. Side tone ranging patterns, as well as digital and voice signals are modulated on a carrier transmitted from the central station and received on all of the supersonic transports. Each aircraft communicates with the ground stations via a different frequency multiplexed spectrum. Supersonic transport position is derived from a computer at the central station and supplied to a local air traffic controller. Position is determined in response to variable phase information imposed on the side tones at the aircraft, and relayed back to the transports. Common to all of the side tone techniques is Doppler compensation for the supersonic transport velocity.

The patent coverage of GSC-10087-1 is directed to transmitting a first side tone spectrum from a first point, transmitting a carrier modulating with a second side tone spectrum from a second point, receiving the first and second spectrums on an aircraft, determining from the phase of the tones the distance of the aircraft relative with the first and second points, determining the distance of the aircraft from the center of the Earth, and then combining the three distances to establish the location of the aircraft.





# TRAFFIC CONTROL SYSTEM AND METHOD

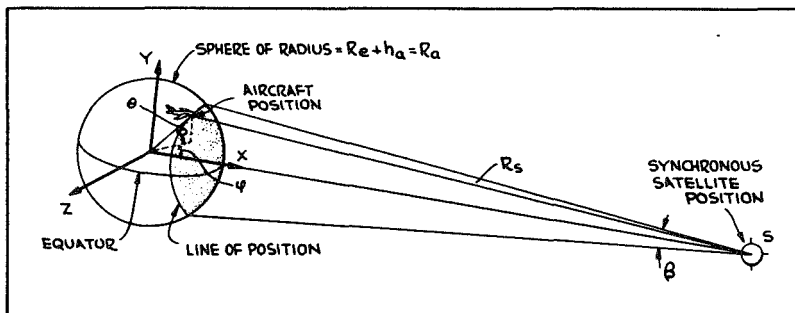
NASA Case No. GSC-10087-2

Australia, Belgium, Canada, France,  
Italy, Japan, Switzerland,  
United Kingdom, West Germany

[Corresponding to U.S. Patent No. 3,495,260]

System and method for position locating, deriving centralized air traffic control data, and communicating via voice and digital signals between a multiplicity of remote aircraft (including supersonic transports) and a central station, as well as a peripheral ground station(s), through a synchronous satellite relay station. Side tone ranging patterns, as well as digital and voice signals are modulated on a carrier transmitted from the central station and received on all of the supersonic transports. Each aircraft communicates with the ground stations via a different frequency multiplexed spectrum. Supersonic transport position is derived from a computer at the central station and supplied to a local air traffic controller. Position is determined in response to variable phase information imposed on the side tones at the aircraft, and relayed back to the transports. Common to all of the side tone techniques is Doppler compensation for the supersonic transport velocity.

The claim coverage of GSC-10087-2 varies in at least one respect in that the Doppler frequency shift on the carrier is utilized to provide a determination of the velocity of the object relative to a satellite station.



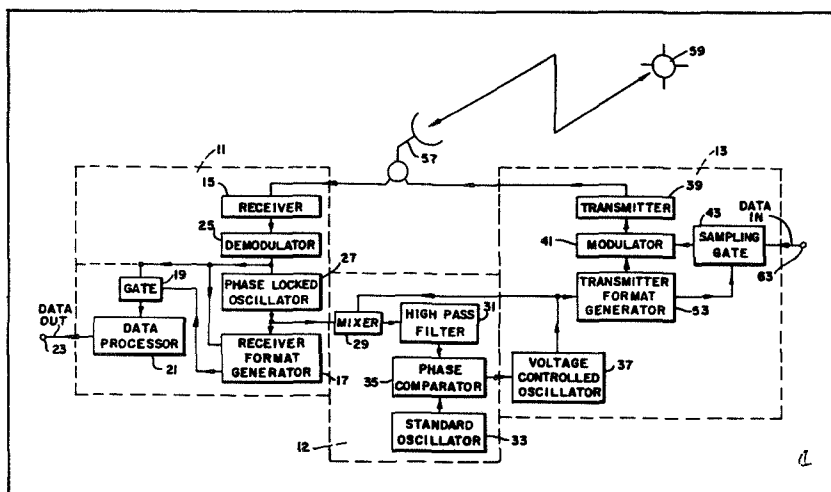
# TIME DIVISION MULTIPLEX SYSTEM

NASA Case No. XGS-05918

Belgium, Canada, France, Holland,  
Italy, Japan, United Kingdom,  
West Germany

[Corresponding to U.S. Patent No. 3,430,237]

Apparatus for synchronizing a satellite time division multiplex system so that signals can be transmitted or received between any of the stations. The system constantly compensates for Doppler shift so that a medium altitude satellite is always in synchronization. Additionally, a system is provided for centering a slave station in an empty slot in the time division multiplex format.



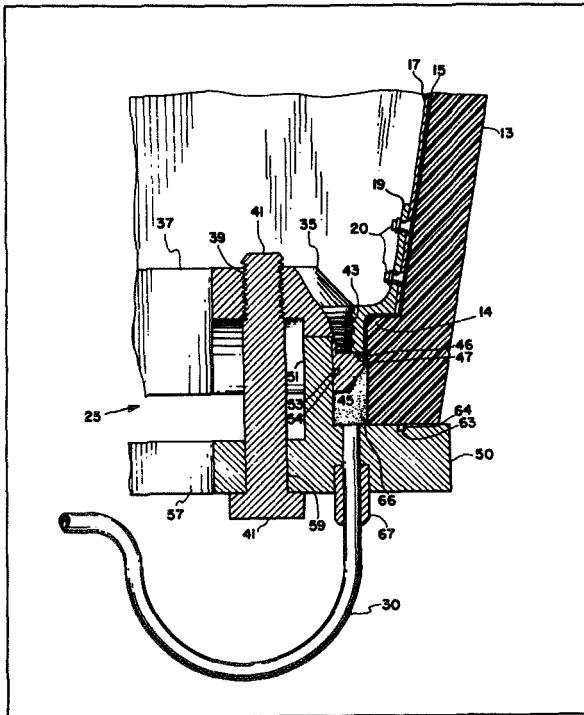
## BONDING PROCEDURE

NASA Case No. XLA-01262

Australia, Canada, France, Italy,  
Japan, Sweden, Switzerland,  
United Kingdom, West Germany

*[Corresponding to U.S. Patent No. 3,356,549]*

The need for thermal protection of certain metal components from extreme temperatures, such as telemetry antennas on spacecraft during atmospheric reentry, has led to the development of a new bonding procedure. The problems caused by the difference in the coefficients of thermal expansion of a protective layer such as a plastic lamination and the metal surface of the component and also the presence of entrained air or vapors in the bonding material have been met by this method of bonding polytetrafluoroethylene to a magnesium alloy surface using a suitable thermosetting epoxy adhesive.



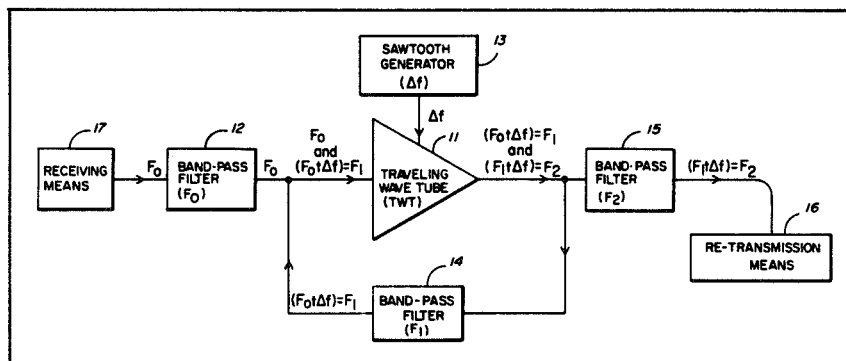
# FREQUENCY CONVERTER RE-ENTRY AMPLIFIER

NASA Case No. XGS-01022

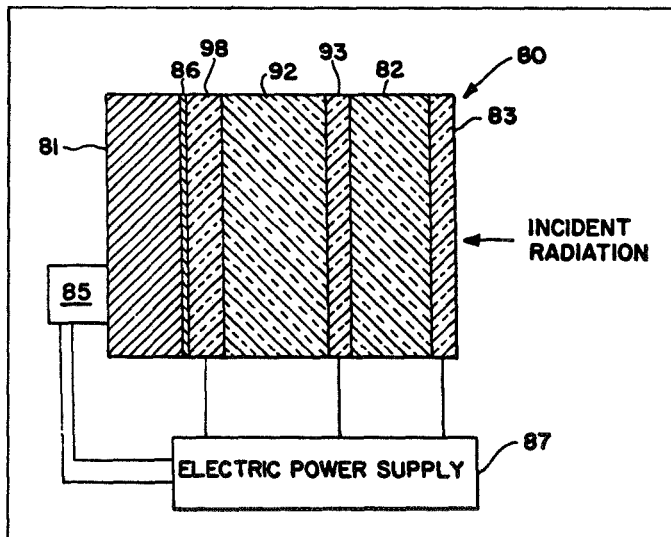
Canada, France, Holland, Italy,  
Japan, Sweden, Switzerland,  
United Kingdom, West Germany

[Corresponding to U.S. Patent No. 3,277,373]

It is essential in many communications systems that microwave carrier frequency signals be amplified. This is generally accomplished by an active repeater which receives the signal, amplifies it, converts it to another microwave frequency and then re-transmits it. The frequency conversion prevents feedback which would cause spurious oscillations in the system. This invention utilizes a traveling wave tube to carry out the dual function of amplifying an input signal and also shifting its frequency. Thus a simple system of few components is used which requires less power for operation and accordingly has application in communications satellite systems.



It is necessary to protect the interior of space vehicles from the extreme environmental temperature changes encountered in space missions. For this purpose a thermo-sensitive panel construction has been developed for achieving selectively changeable and controllable surface solar absorptivity/emissivity ratios. The result is obtained by altering the molecular structure of the panel construction through such changes as electroluminescence, semiconductivity, photovoltaic effect and electro-optical polarization.



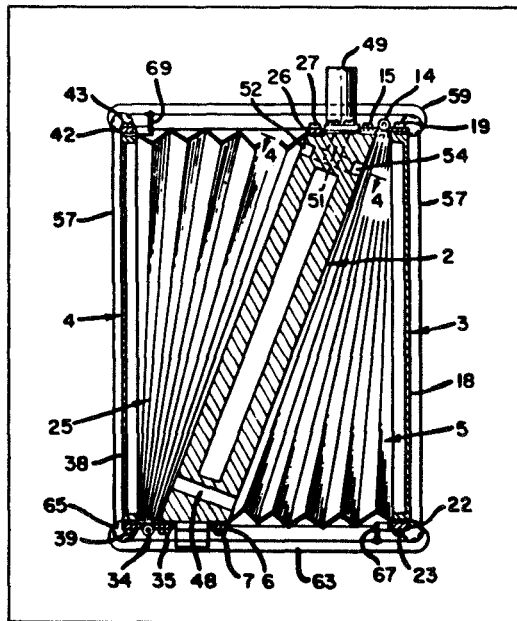
## BALANCED BELLOWS SPIROMETER

NASA Case No. XAC-01547

Canada, France, United Kingdom

[Corresponding to U.S. Patent No. 3,420,225]

A laboratory instrument for measuring total lung capacity, vital capacity, maximum breathing capacity, tidal volume, functional residual capacity and oxygen uptake of human subjects. The spirometer, which employs two mechanically interconnected bellows, is compact, retains calibration, and is unaffected by acceleration fields along all three coordinate axes.



# FOAMED IN-PLACE CERAMIC REFRACTORY INSULATING MATERIAL

NASA Case No. XGS-02435

Canada

*[Corresponding to U.S. Patent No. 3,382,082]*

In many applications there is a need for providing vibration shielding and also thermal protection for electrical components. Most prior potting compositions, while providing mechanical vibration protection, do not exhibit satisfactory thermal characteristics. On the other hand, some prior art refractory materials are known to have excellent thermal properties; however, electrical components cannot be potted directly in them because the extremely high temperatures required in the curing portion of the potting process would damage or destroy the components. In such cases it was necessary to prepare refractory blocks of various shapes which were then fitted around the objects to be protected. The obvious disadvantages of this procedure are obviated by this invention which may be foamed in-place since its curing time and temperature are relatively low. The invention has other uses such as in furnaces and in the construction industry as a low-cost, easily workable insulating material.

## **FIRE RESISTANT COATING COMPOSITION**

**NASA Case No. GSC-10072**

**Australia, Belgium, Canada, France,  
Holland, Italy, Japan, Switzerland,  
United Kingdom, West Germany**

*[Corresponding to U.S. Patent No. 3,493,401]*

Fire resistant coating compositions intended for high temperature applications, which when dried are flake, crack, craze, and abrasion resistant and of greatly reduced leachability. The compositions, which are combinable with selected conventional pigments and fillers, comprise a combination of a potassium silicate solution, ceric oxide, and/or alkyl trialkoxy silane as rehydration suppressants, and wollastonite as a film builder.

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## **POTASSIUM SILICATE-ZINC COATINGS**

**NASA Case No. GSC-10361**

**Australia, Belgium, Canada, France,  
Holland, Italy, Japan, Switzerland,  
United Kingdom, West Germany**

*[Corresponding U.S. Patent—Application Pending]*

Zinc dust coatings which, when dried on a metal surface, are crack, craze, and abrasion resistant. The coatings are formed by combining a potassium silicate solution with zinc dust and, optionally, including an alkyl trialkoxysilane. These compositions of basically inorganic materials are intended primarily for the protection of metals subject to adverse environmental conditions.



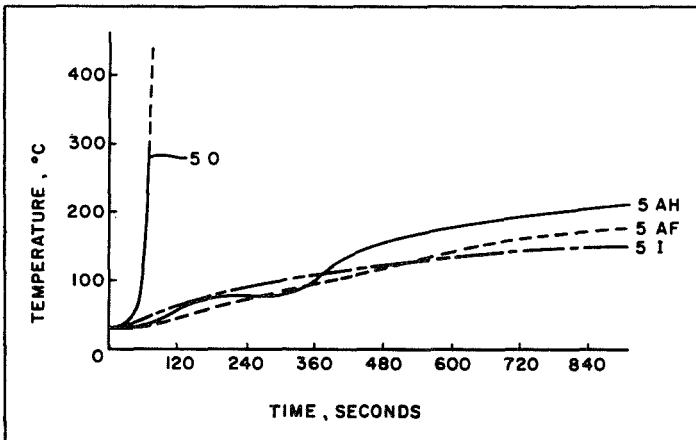
## FIRE RETARDANT FOAMS

NASA Case No. ARC-10098

Australia, Belgium, Canada, France,  
Holland, Italy, Japan, Sweden, Switzerland,  
United Kingdom, West Germany

*[Corresponding to U.S. Patent No. 3,549,564]*

This invention improves upon polyurethane foams as fire resistant materials by improving their characteristics and by imparting fire suppressant and fire retardant characteristics. The main structure of the material is a rigid or semi-rigid polyurethane foam, preferably of a highly branched structure, in which are incorporated one or more materials to impart special properties. Modified foams have been developed which provide effective protection for thermally sensitive structures against the destructive action of fuel-fires. The invention relates to the modification of closed cell rigid and semi-rigid polyurethane foams in the density range of from 0.50 to 50 pounds per cubic foot. The modifying agents include three types: a certain class of alkyl halide resins, a certain class of inorganic salts, and encapsulated halogen bearing volatile molecules. The modified foam may then be applied by conventional methods. Outstanding protection against fire has been achieved.



\*Exclusively licensed to Avco Corporation. Please direct inquiries to: Fire Protection Materials, Avco Corporation, Avco Systems Division, Lowell Industrial Park, Lowell, Massachusetts 01851.

## INTUMESCENT PAINTS

NASA Case No. ARC-10099

Australia, Belgium, Canada, France,  
Holland, Italy, Japan, Sweden, Switzerland,  
United Kingdom, West Germany

*[Corresponding to U.S. Patent No. 3,535,130]*

Intumescent (swelling or expanding) paints useful for fire protection have been produced. Conventional intumescent paints suffer from many disadvantages including sensitivity to water and other solvents, little resistance to scuffing and abrasion, sensitivity to thermal erosion by flames, and limited efficiency in the protection of substrates under thin steel plate or sheet. This paint overcomes these disadvantages and provides outstanding protection. The intumescent material is an aromatic nitroamino compound in the form of its sulfate, either dissolved or dispersed in a vehicle, or prepolymerized, or both. Upon heating, such a paint intumesces, chars and provides a flame resistant coating.

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**MODIFIED POLYISOCYANURATE  
POLYMER FOAM**

NASA Case No. ARC-10280

Canada, France, Italy, Japan,  
United Kingdom, West Germany

*[Corresponding to U.S. Patent—Application Pending]*

The subject matter of this invention is directed to a fire retardant polyisocyanurate foam which is resistant to high temperatures and which has exceptional dimensional stability. In general, the present invention is carried out by reacting an organic polyisocyanate in the presence of a blowing agent and catalyst with a low hydroxyl number, high molecular weight linear polyether polyol comprising a condensation product of a multi-functional polyol and propylene oxide with grafted polyacrylonitrile branched side chains. Thus the crux of the present invention is the employment of a polyol having grafted acrylonitrile side chains which cyclize at elevated temperatures to form stable heterocyclic structures. By employing the polyol having a high molecular weight and low hydroxyl number, only small amounts of the isocyanate groups are consumed to form urethane linkages.

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**POLYMERIC VEHICLES AS CARRIERS FOR  
SULFONIC ACID SALT OF NITROSUBSTITUTED  
AROMATIC AMINES**

NASA Case No. ARC-10325

Canada, Japan, United Kingdom, West Germany

*[Corresponding to U.S. Patent—Application Pending]*

Intumescent coatings when applied to the surface of an article provide protection from fire and heat. Many applications of the coatings (or paints) are envisioned which include use in schools, homes, office buildings, ships, spacecraft, aircraft, etc. This invention relates to an intumescent agent which contains the ammonium salt of 4-nitroaniline-2-sulfonic acid and a polymer of the mercaptan type which may contain disulfide linkages or polyoxyalkylene linkages. The adhesion and char resistance of such compositions can be further improved by the addition of epoxy resins. The composition exhibits high hydrolytic stability.

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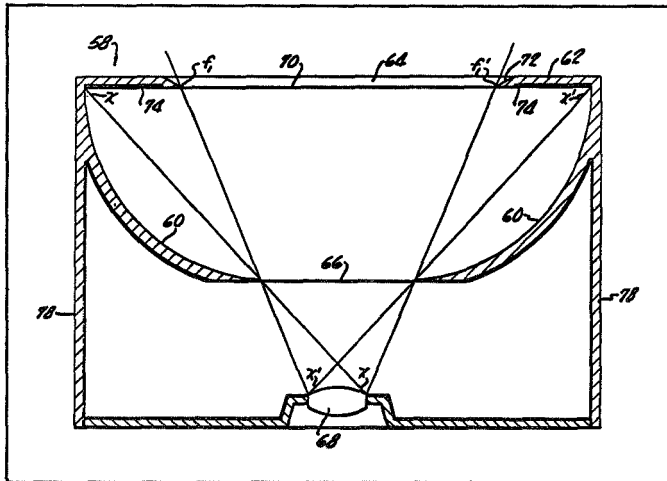
# ANTI-GLARE IMPROVEMENT FOR OPTICAL IMAGING SYSTEMS

NASA Case No. NPO-10337

Belgium, Canada, France, Great Britain,  
Italy, Japan, West Germany

[Corresponding to U.S. Patent No. 3,488,103]

This invention is directed to an anti-glare baffle for shading rays such as light rays or other radiant energy rays which emanate from outside a desired field of view. The device may find use in sensitive still and movie cameras, light meters, telescopes, radiometers, photometers, electro-optical position sensors, photocell shades, star tracking devices and the like. The anti-glare baffle has a specularly reflective surface formed from an oblate hemispheroid. A shading flange extends inwardly from the upper edge of the hemispheroid and intersects the foci of the oblate hemispheroid. The oblate hemispheroid and flange surround a viewing aperture and spaced ray detecting device.



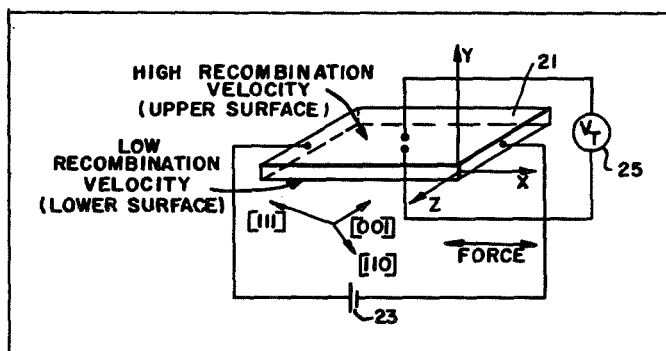
# TRANSVERSE PIEZORESISTANCE AND PINCH EFFECT ELECTROMECHANICAL TRANSDUCERS

NASA Case No. ERC-10088

Canada, France, Holland, Japan,  
United Kingdom, West Germany

[Corresponding U.S. Patent No. 3,537,305]

This invention is a replacement for strain gages and accelerometers. The device may be used in any environment where conventional piezoresistive or strain gage electromechanical transducers can be used. In addition to the foregoing uses, the device can be used in bioelectric sensing due to its small size. The transducer, of anisotropic piezoresistive material, includes a body of semiconductor material having a longitudinal force axis that is skewed with respect to the crystallographic orientation of the body. The material combines the pinch effect with the piezoresistive effect. The device produces a much larger electrical signal for a given stress than presently known in the prior art.



NASA Case No. ERC-10125

[Corresponding U.S. Patent No. 3,541,428]

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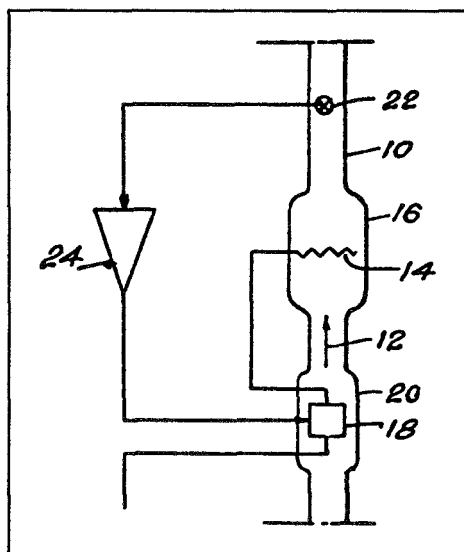
# APPARATUS FOR CONTROLLABLY HEATING FLUID

NASA Case No. XMF-04237

Canada

*[Corresponding U.S. Patent—Application Pending]*

This invention is associated with fluid heating devices which operate by circulating fluid past an electronically controlled heater element in a flow conduit. The efficiency of such devices is increased by placing the heater control components in the conduit, upstream from the heater element, thereby utilizing the heat generated in the control components for preheating the fluid anterior to the principal heater element.





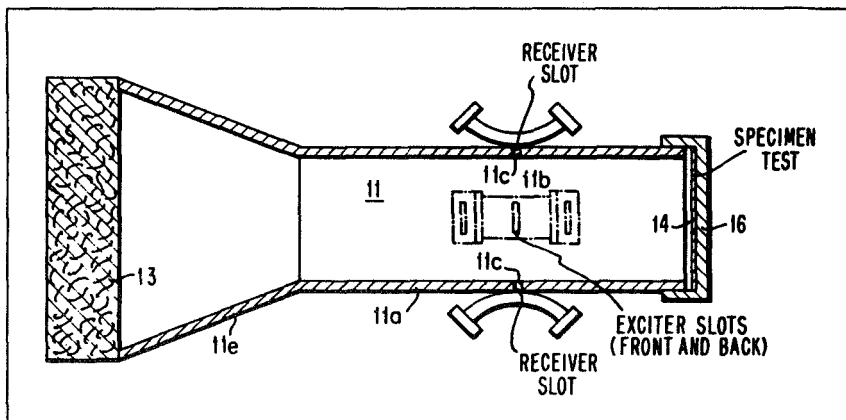
# MICROWAVE FLAW DETECTOR

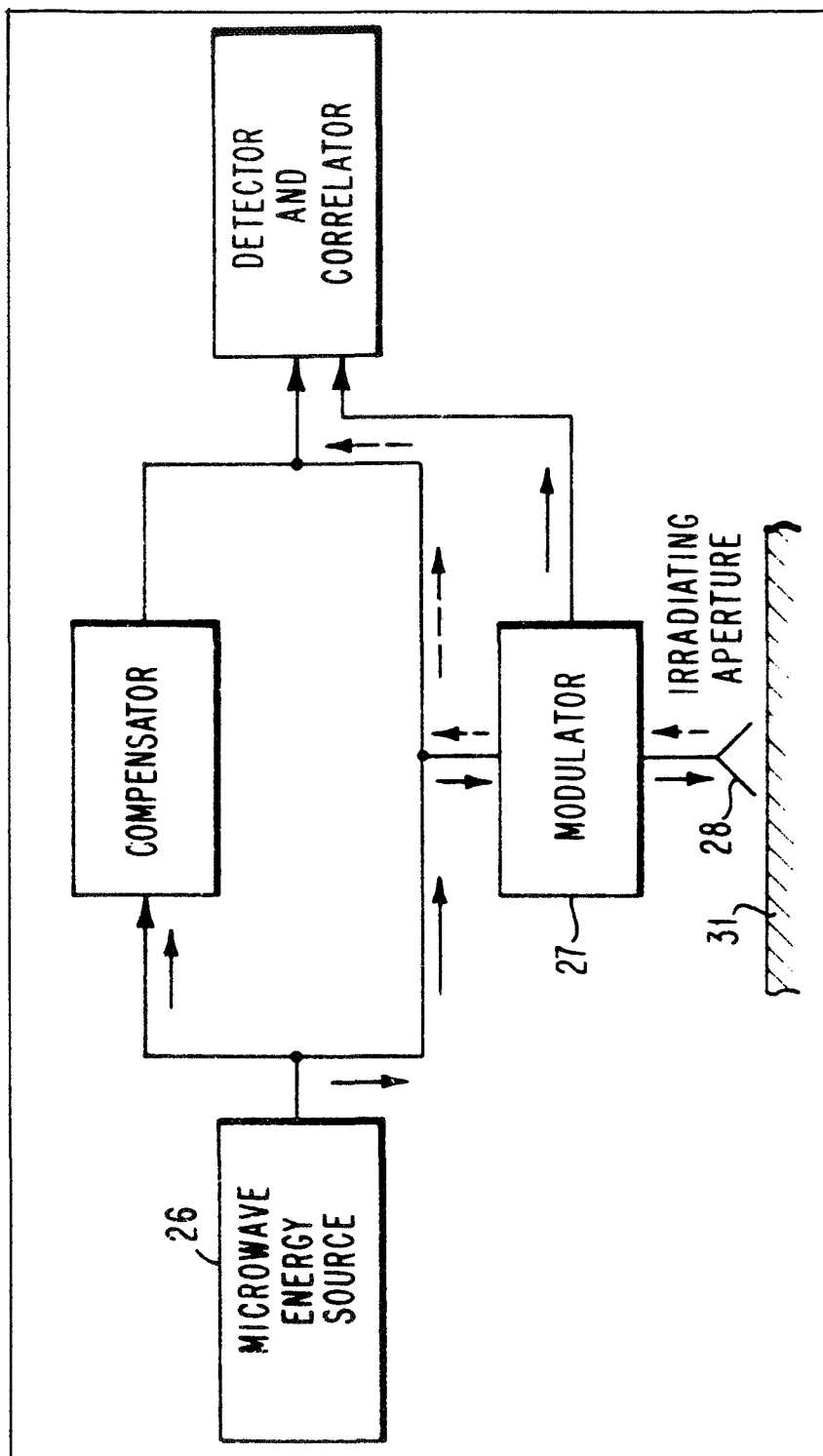
NASA Case No. ARC-10009

Canada

[Corresponding to U.S. Patent No. 3,532,973]

The basic theory of a microwave metal surface flaw detector is that irradiation of a flawed metal surface by electromagnetic microwave energy results in re-emission of electromagnetic energy from the surface in a pattern of eigenmodes different from those of the original irradiating signal. The incident microwave signal must satisfy the electromagnetic boundary conditions on the surface of the specimen. In accordance with the present invention, there is provided a flaw detection system utilizing microwave energy which is radiated to the test surface and which varies in a cyclic or return-to-zero manner. The test surface modifies the reflected electromagnetic energy, in accordance with the surface condition, so that the reflected energy provides a measure of the surface condition as a function of the cyclic scan angle. This reflected energy is demodulated and then correlated, either with itself or with a reference pattern, to provide an indication of irregularities in the surface.





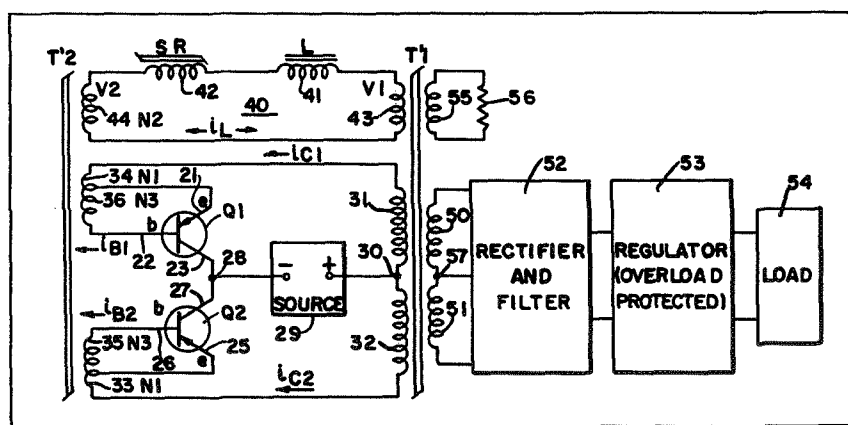
# INVERTER WITH MEANS FOR BASE CURRENT SHAPING FOR SWEEPING CHARGE CARRIERS FROM BASE REGION

NASA Case No. XGS-06226

Belgium, Canada, France, Japan,  
United Kingdom, West Germany

*[Corresponding to U.S. Patent No. 3,466,570]*

Inverters are utilized for converting a source of direct current to alternating current, or alternately for converting a source of direct current to a first voltage level alternating current and then to a second desired direct current voltage level. The concept employed in the inverters of this invention employs semiconductors and utilizes means for base current shaping for sweeping charge carriers from the base region. More specifically, the provision of both an inductance and a saturable reactor in the frequency determining network of a push-pull transformer coupled oscillator-inverter drastically improves performance. The circuit inhibits abnormal surges, spikes or ripples which are usually present at an energy source output. Short circuit protection is provided and increased reliability and efficiency is obtained by reducing the switching transistor overlap without requiring the application of a high inverse base to emitter voltage. A further feature is the provision of a means for controllably separating the base drive current reduction (switching-off transistor) and base drive current overdrive (switching-on transistor) into two distinct and separate time intervals.



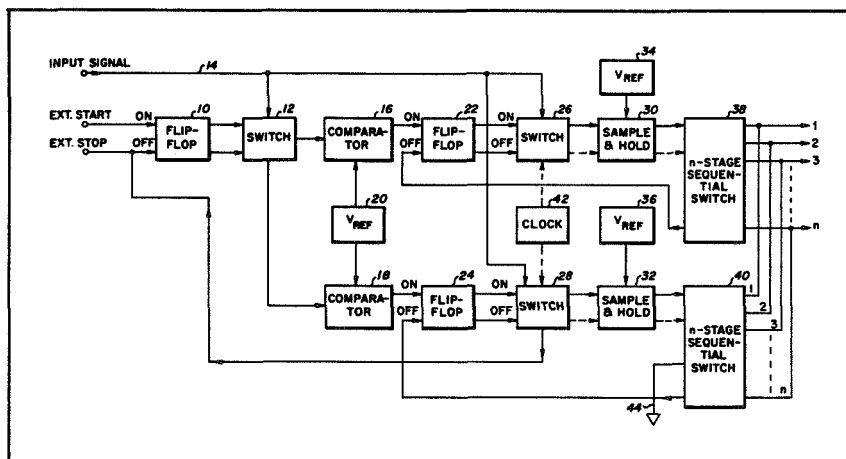
# METHOD AND APPARATUS FOR MEASURING THE DAMPING CHARACTERISTICS OF A STRUCTURE

NASA Case No. ARC-10154

Canada, France, Japan,  
United Kingdom, West Germany

*[Corresponding to U.S. Patent—Application Pending]*

Spectral analyzers and correlation computers have been used in the past to provide the most useful damping data heretofore available; however, these types of apparatus either require too much time to obtain accurate values of damping characteristics or can only be used with linear systems. The present invention relates to an automatic on-the-line instrument for measuring the damping characteristics of a structure or system during excitation by random forces or influences. The apparatus is comprised of at least two parallel sampling circuits which perform time sequential sampling operations on predetermined portions of a given input signal. After summing the outputs of the sampling circuits at output terminals, a sampling transient indicative of a point on the damping characteristic of the structure can be obtained.



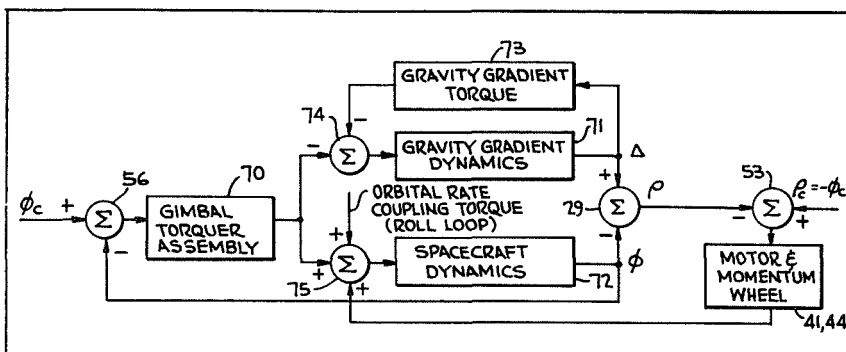
# GRAVITY GRADIENT ATTITUDE CONTROL SYSTEM

NASA Case No. GSC-10555

Canada, France, Italy, Japan,  
United Kingdom, West Germany

[Corresponding to U.S. Patent No. 3,567,155]

A system for controlling and stabilizing the attitude of an artificial earth satellite includes a gravity gradient member mounted in a gimbal arrangement to have two degrees of freedom. The angular deviation of the gravity gradient member and the satellite relative to the local vertical and the spacecraft angle command input signal selectively drive a plurality of inertial momentum wheels, one for each of the three spacecraft axes, provided to dampen the gravity gradient member librations. The gravity gradient member is controlled so that the equilibrium position of the longitudinal axis thereof is maintained in alignment with the local vertical in response to signals indicative of the rate of change of movement thereof with respect to the remainder of the satellite and a signal indicative of the angular deviation of the satellite position from the angle command.



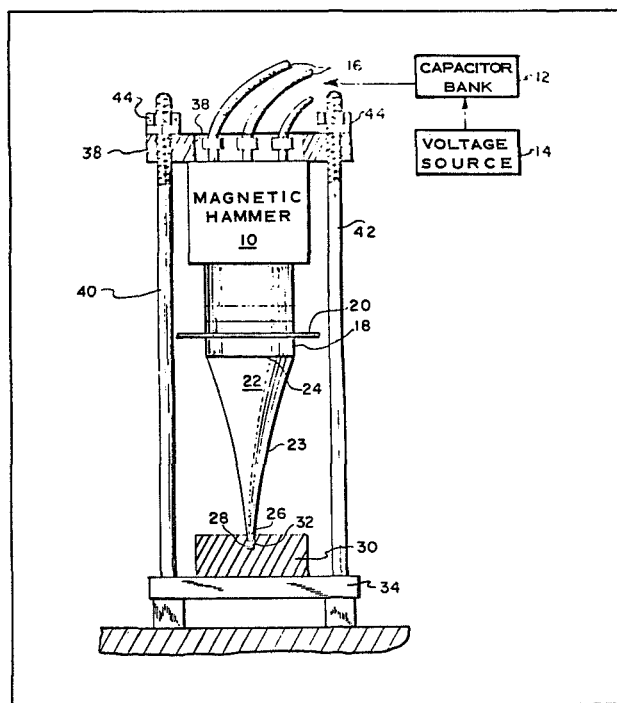
# PROCESS AND APPARATUS FOR MAKING DIAMONDS

NASA Case No. MFS-20698

Canada, France, Japan,  
United Kingdom, West Germany

*[Corresponding to U.S. Patent—Application Pending]*

Diamonds of industrial grade may be fabricated from graphite by this simple but effective apparatus. An exponential horn is vertically positioned with its small end in a graphite receiving pocket. A magnetic hammer above the horn, generates a shock wave in the exponential horn and due to the horn geometry, the velocity of the shock wave is amplified and the shock wave energy concentrated so that all of the energy arrives simultaneously at the small end of the horn. This energy is transferred to the graphite in the anvil pocket and results in pressure and temperature levels that causes the graphite to be transformed, in part, to diamonds.



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